

SEASONAL DISTRIBUTION OF *NAJADICOLA*
INGENS (K.) (ACARINA) IN A
NEW HAMPSHIRE POND

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Certain aspects of the geographical distribution and host relationships of *Najadicola ingens* (Koenike), a water-mite parasitic in fresh-water clams, have been investigated (Humes and Jamnback, 1950), but its seasonal distribution has not been reported. Wash Pond, Hampstead, New Hampshire, was selected for a study of the seasonal incidence and distribution of the mite. This pond was particularly suitable because of the high percentage of clams known to be parasitized there.¹ During the 13 months from December, 1949, to December, 1950, inclusive, a total of 2211 clams, representing three species, was examined for mites. Collections were made monthly, as nearly as possible to the 15th, but in no case earlier than the 14th or later than the 19th day. All clams were collected in 6-30 inches of water from a strip of sandy shore about 500 feet in length at the west end of the pond near an outlet brook.

The three species of clams found and the number of each examined were: *Anodonta cataracta* Say, 1147 specimens, *Elliptio complanatus* Solander, 1038, and *Lampsilis radiata* (Gmelin), 26. The size of each monthly collection and the number of each clam species contained therein (Table 1) varied, because of difficulties in collection, caused by ice, wind, and burrowing of the clams in winter. When possible at least 100 individuals of each clam species were collected. Data concerning *A. cataracta* for February and March had

¹Humes, A. G., and H. A. Jamnback. 1950. *Najadicola ingens* (Koenike), a water-mite parasitic in fresh-water clams. *Psyche*, 57(3):77-87.

less meaning than for the other months because of the small numbers of clams collected.

The temperature on the bottom of the pond at a depth of about 24 inches varied from 0.5 degrees C. in March to 26.5 degrees C. in July (Graph 1). The pond was covered with ice in January, February, and March.

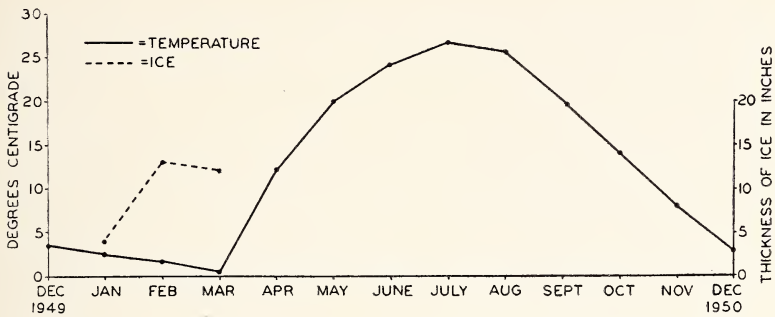
Throughout the 13 months *A. cataracta* was very frequently either parasitized by mites or had papillae in the suprabranchial chambers (which is evidence of having been parasitized) (Table 1). Mites were found in 886 or 77.2 per cent of the 1147 *A. cataracta* (a figure lower than the 87.3 per cent given by Humes and Jamnback, 1950, which was based upon a single November collection) and papillae only in 160 or 13.9 per cent. The total number of *A. cataracta* parasitized or with papillae was 1046 or 91.2 per cent, leaving 101 or 8.8 per cent unparasitized and without papillae.

E. complanatus was parasitized or had papillae much less frequently than *A. cataracta* (Table 1). *N. ingens* occurred in 19 or 1.8 per cent of the 1038 *E. complanatus*. No papillae were observed in the suprabranchial chambers of this species.

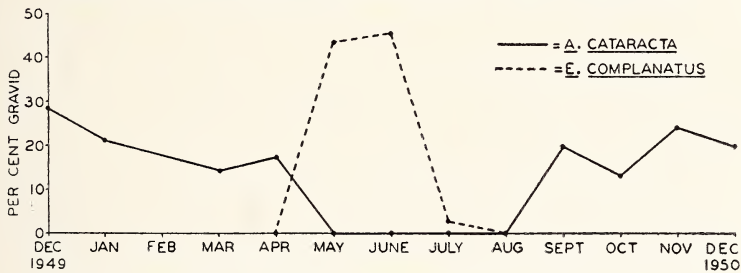
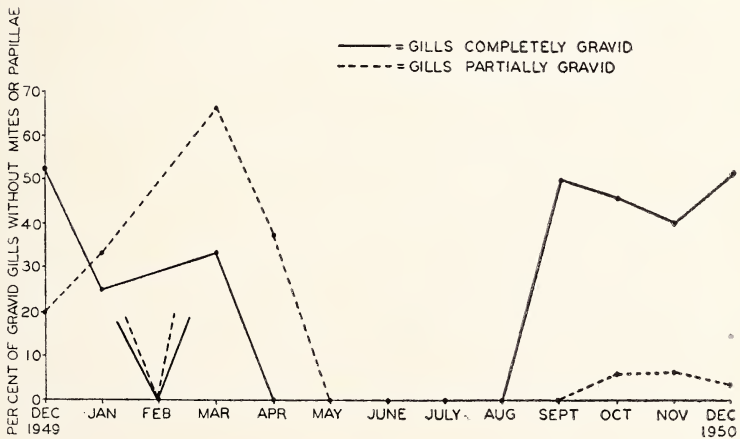
No *N. ingens* were found in *L. radiata*.

Adult male and female *N. ingens* occurred throughout the 13 months. The frequencies of clams with one male and one female adult mite, with males only, or with females only, showed no seasonal trends. Four hundred and fifty-five, or an average of 35 or 51.4 per cent per month (extremes of 5-64 or 41.6-66.6 per cent) of the parasitized *A. cataracta*, had at least one male and one female mite. Three hundred and twenty, or an average of 24.6 or 36.1 per cent (3-62 or 25.0-50.0 per cent), had male mites only. One hundred and eleven, or an average of 8.5 or 12.5 per cent (1-22 or 5.2-27.6 per cent), had female mites only.

A. cataracta with glochidia in the gills was found from September to April inclusive (Graph 2). All glochidia were shed by the middle of May, when the bottom temperature had risen to 20 degrees C. The gills were not found gravid again until the middle of September, when the



GRAPH 1. BOTTOM TEMPERATURE AND THICKNESS OF ICE IN WASH POND.

GRAPH 2. MONTHLY OCCURRENCE OF GRAVID *A. CATARACTA* AND *E. COMPLANATUS*.GRAPH 3. MONTHLY OCCURRENCE OF COMPLETELY AND PARTIALLY GRAVID GILLS IN UNPARASITIZED *A. CATARACTA*.

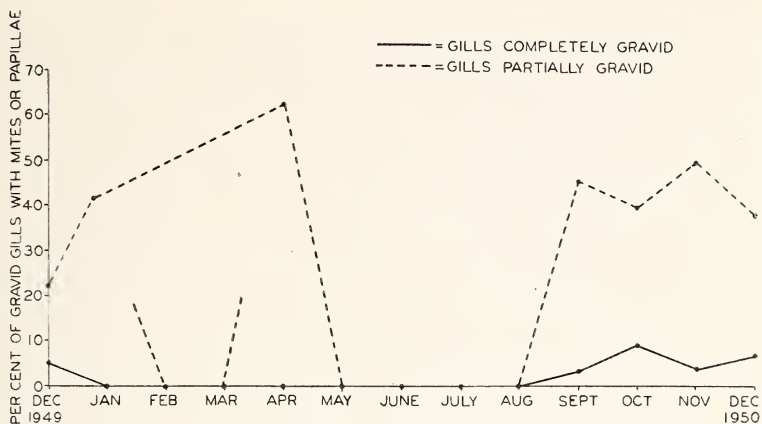
bottom temperature had dropped to 19.5 degrees C. At that time many clams were gravid (19.1 per cent of all *A. cataracta* of both sexes, both parasitized and unparasitized, collected in September).

In unparasitized *A. cataracta* without papillae gravid gills tended to be filled completely with glochidia in September and through the winter months (Graph 3). No gravid clams were found in the small February sample. The reference lines to February are not connected to the rest of the graph because of the inadequate sampling. As spring approached, the glochidia were gradually shed, and the percentage of clams with partially filled gills increased, reaching a high point in March. By May all gravid clams contained only a relatively few glochidia, usually in the central part of the gills. During this time the percentage of clams with completely filled unparasitized gills became smaller.

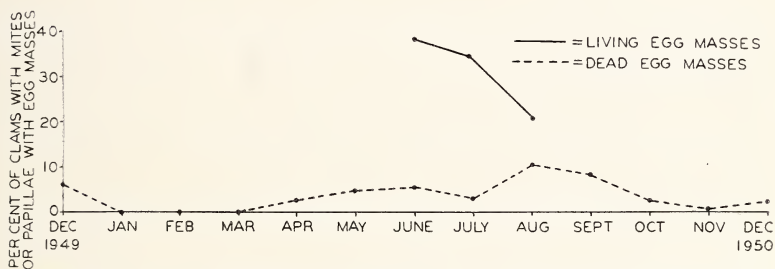
In parasitized gills or those with papillae the glochidia completely filled the gills in only a relatively few cases, and then only during September to December inclusive (Graph 4). No gravid clams were found in the small February and March collections. As in Graph 3, the reference lines to these months are not connected to the rest of the graph. Most gills with mites or papillae were incompletely filled with glochidia even early in the gravid period. For example, in September 46.3 per cent of all the gravid gills with mites or papillae were partially filled, while only 3.7 per cent were completely filled. On the other hand, in the same month all unparasitized gravid gills were completely filled.

Glochidia were found in the gills of *E. complanatus* from May to July inclusive (Graph 2). These clams were first found gravid in the middle of May, when the water temperature had risen to 20 degrees C., and were shed by the middle of August, when the temperature was 25.5 degrees C. No significant data on the seasonal distribution of the mites in this species were collected, since so few clams were parasitized (Table 1).

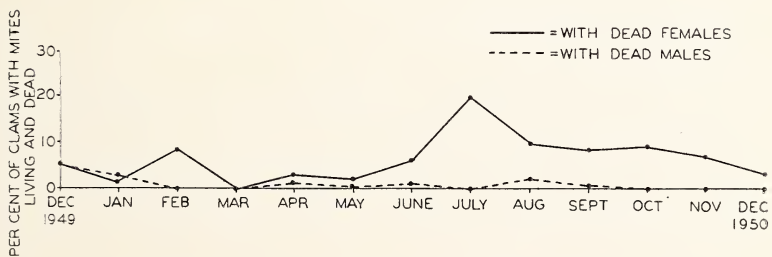
Living egg masses of *N. ingens* were present in *A. cataracta* only in June, July, and August (Graph 5), coincid-



GRAPH 4. MONTHLY OCCURRENCE OF COMPLETELY AND PARTIALLY GRAVID GILLS IN PARASITIZED *A. CATARACTA*



GRAPH 5. MONTHLY OCCURRENCE OF LIVING AND DEAD EGG MASSES IN *A. CATARACTA* WITH MITES OR PAPILLAE



GRAPH 6. MONTHLY OCCURRENCE OF DEAD MALE AND FEMALE MITES IN PARASITIZED *A. CATARACTA*.

ing with the time when the water temperature had reached its maximum of 26.5 degrees C. In June 38.1 per cent of the number of clams with mites or papillae for that month contained masses of living mite eggs. The eggs at this time were all white or light yellow, indicating that they had been laid recently. Observations of Humes and Jamnback (1950) have indicated that the eggs when first laid are light cream in color, but darken as development progresses to almost black at hatching, which may occur in 17 days in distilled water at summer room temperatures. In July many of the egg masses were various shades of brown, and some had already hatched. In August only 20.8 per cent of the clams with mites or papillae contained egg masses. These were generally dark in color or already hatched. A few, however, were light cream in color, indicating recent oviposition.

Dead egg masses were found in all months except January, February, and March (Graph 5). The absence of dead egg masses in these three months may be accounted for by the relatively small size of the samples of clams collected. Dead egg masses were never found in more than 10.4 per cent (in August) of the clams with mites or papillae. Apparently egg masses which were laid late in the period of oviposition and had not hatched by the middle of September died and remained in the suprabranchial chambers for several months. The dead egg masses found in April and May must have been laid during the preceding summer, since oviposition did not begin until sometime after the middle of May.

No egg masses were found in *E. complanatus* or in *L. radiata*.

Dead *N. ingens* (Graph 6) were found in parasitized *A. cataracta* in every month except March, a month when the small clam sample could account for their absence. Dead males occurred in small numbers during 6 of the 13 months, with no significant seasonal variation. Dead females occurred in every month except March, but were most abundant in July and succeeding few months. The sudden increase in incidence of dead females in July to 20.3 per cent of the parasitized *A. cataracta* occurred one month after

	<i>A. cataracta</i>				<i>E. complanatus</i>			<i>L. radiata</i>		
	total number	number with mites	number with papillae only	% of total with mites or papillae	total number	number with mites	% with mite	total number	number with mites	% with mites
December 1949	57	38	9	82.5	5					
January 1950	38	30	8	100.0						
February	13	12		92.3	98	3	3.1			
March	14	12	1	92.9	17					
April	111	99	10	98.2	107	1	0.9	2		
May	117	92	14	90.6	111	1	0.9	4		
June	102	78	19	95.1	102	1	1.0	16		
July	76	59	8	88.2	108					
August	107	80	16	89.7	120	5	4.2	4		
September	131	103	19	93.1	131	1	0.7			
October	117	87	17	88.9	126	2	1.6			
November	170	139	21	94.1	97	5	5.1			
December	94	57	18	79.8	16					
Total	1147	886	160	91.2	1038	19	1.8	26	0	0
Average %										

Table 1. Size of monthly clam collections, number of clams parasitized or with papillae, and percentage parasitized or with papillae.

the time of maximum oviposition in June (Graphs 5 and 6). This fact suggests that at least some females die after oviposition and that their bodies may remain in the supra-branchial chambers for several months.

Nymphs of *N. ingens* occurred in small numbers in all but 4 of the 13 months (December, January, May, and September) with no significant seasonal variation.

The total number of mites recovered from the 1147 *A. cataracta* was 1400 (with monthly extremes of 17-207), comprising 893 males (11-137) and 507 females (6-74). This gave an average of mites of either sex per parasitized clam of 1.58 (1.22-1.85). During the 13 months neither the average number of mites per parasitized clam nor the percentage of males and females changed significantly. The average monthly percentage of males in the total of 1400 mites was 63.8 per cent (52.4-67.2), while that of females was 36.2 per cent (32.7-47.6). The sex ratio of males to females was 1.76:1.

The distribution of adult mites among the four supra-branchial chambers of *A. cataracta* did not vary significantly throughout the 13 months. The most frequently occupied position was the outer suprabranchial chambers (in 865 or 97.6 per cent of the 886 parasitized clams). In a few clams mites occurred in the inner suprabranchial chambers (7 or 0.8 per cent) and in both outer and inner chambers (14 or 1.6 per cent).

SUMMARY

1. Monthly collections from December, 1949, to December, 1950, inclusive, in Wash Pond, New Hampshire, showed *Najadicola ingens* to occur most commonly in *Anodonta cataracta* and occasionally in *Elliptio complanatus*. The mite did not occur in *Lampsilis radiata*. The monthly incidence of adult male and female mites showed no significant seasonal changes.

2. The gills of *A. cataracta* were gravid from September to May inclusive. In gills with mites or papillae the glochidia usually only partly filled the gills, even early in

the gravid period, when unparasitized gills without mites or papillae were completely gravid.

3. Living egg masses of *N. ingens* were found in *A. cataracta* only in June, July, and August, months which coincided with the highest water temperature. June egg masses were recently laid, July masses were older for the most part, and August masses were mostly near hatching or had already hatched. This indicated a rather sudden oviposition early in June, followed by a slackening of egg laying until September, when it ceased. Egg masses which have not hatched by September probably die and may remain in the suprabranchial chambers for several months.

4. Dead adult males were found in *A. cataracta* throughout the 13 months in about equal numbers. Dead adult females were most abundant in July, one month after the maximum oviposition, suggesting that at least some females die after oviposition and that their bodies may remain in the suprabranchial chambers for several months.

5. Nymphs were found in small numbers in *A. cataracta* in all but 4 months (December, January, May, and September) without significant seasonal variation.

6. An average number of 1.58 adult mites per parasitized clam was recovered from *A. cataracta*. This average number and the relative numbers of male and female mites showed no seasonal trends. The sex ratio of males to females was 1.76:1.

7. Throughout the 13 months the mites most often occurred in the outer suprabranchial chambers of *A. cataracta*. In only a few cases were mites found in the inner or in both outer and inner suprabranchial chambers.